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Volume XVIII FEBRUARY, 1931 Number 2

GOLF COURSE DESIGN AND CONSTRUCTION

By Wayne B. Stiles *

(Presented at a meeting of the Boston Society of Civil Engineers, December 17, 1930)

A successful golf course architect should have the training and experience acquired along various lines, namely:

1. A sound knowledge of the game itself and how various shots should be played.

2. A knowledge of civil engineering, because one of the first steps in laying out a golf course is to have an accurate outline survey and a topographical survey, if possible, of the area to be used.

A thorough understanding of problems of grading and drainage is always necessary to work out an economical layout for the golf course.

3. The training of a landscape architect is also very useful in that a good knowledge of the various growth and habits of trees and shrubs is essential in designing a finished course.

The problems of the arrangement and design of the parking area, tennis courts, swimming pools and driveways must be so worked out that the club house site will fit into the picture as a whole.

4. A general knowledge of architecture is also very helpful because many minor buildings and structures have to be designed and properly located. Oftentimes the selection of a site itself will determine the best type of architecture for the club house.

5. A thorough knowledge of soil and turf conditions and their proper fertilization is also essential.

In commenting on the above, I would strongly advise any individual or group of men never to allow any one, however fine a player, to lay

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* Golf Course and Landscape Architect of the firm of Stiles & Van Kleek, Inc., 97A Newbury Street, Boston, Mass., and St. Petersburg, Fla.

out a course unless he has had plenty of experience and has done good work in the past. Too many clubs in the past have suffered severe financial loss from experimentation in construction. A great deal of our work today, and I believe will be in the future, is the remodeling of poorly laid out courses. A man may have a good technical knowledge of various kinds of construction, but it seldom means that he can design and construct a course properly until he has experimented on many unfortunate clients.

DIFFERENT TYPES OF COURSES

1. *Municipal and Public Courses.* — Very few cities today are fortunate enough to own land that is really suitable or adapted for a good golf course. If such land is not owned it is only after careful inspection of various tracts that the final selection should be made.

It is only too often that the question of price or political friendship enters into the selection of such a property, but usually a golf course becomes a public park and is dedicated for such purposes forever afterwards, and every effort should be made to select the best possible site.

On account of the crowded conditions of these courses it is considered advisable to clear up practically the entire area and leave no areas for rough, where balls will be lost and hold up the play. Otherwise these courses should be designed equally as well as any private course, with the exception that the placing and design of the traps should not penalize as severely as the ones for a private course.

2. *Semi-Public and Commercial Courses.* — These courses are laid out practically along the same lines and specifications as those for public courses.

In the past it has not been thought necessary to make these courses especially interesting, and today there are too many of the so-called "cow pasture" type.

Competition in the future will enter into the financial success of these courses, and I strongly believe that in the future they will be designed and constructed equally as good as any private course.

3. *Private Club Courses.* — The majority of golf clubs in the United States today are owned by clubs or groups of individuals, and are organized and controlled for the benefit of the members. The type of land which is selected, design of holes and construction of same, usually depend mainly on the financial backing which these clubs have. Many mistakes have been made in the past and clubs started with insufficient financing, which always causes trouble and delays in securing sufficient membership necessary to carry on the expenses of such an organization.

careful study of all expenditures necessary should be made in the eginning and a financial program laid out, perhaps over a period of ears, if the future success of such a club is to be secured.

Plans for Course

The first step in designing a new layout, after final selection of the te has been determined upon, is the location of the club house site. enerally speaking, the club house should never be located at one end corner of the property, inasmuch as it is very hard to properly design e two loops of 9 holes each and bring each back to the club house ithout congestion on some of the holes.

It is better to make a selection of the club house site nearer the enter of the property, or at least along the center of one side of the roperty. It is seldom considered advisable to locate the club house the top of a hill, however fine the view may be, as severe climbs will necessary at the end of each 9 holes to bring the players back to the ub house.

Other conditions to be considered in the selection of this site are e location and area of the parking space, which today requires a large ea. A well selected site should be provided, in addition to the location the club house and parking area, with the location and setting for e first and tenth tees and the ninth and eighteenth greens, all within sy reach of the club house itself. Enough area within easy reach of e club house should also be set aside for a practice area.

Very often tennis courts, swimming pools, bowling greens and her details are desired, and a suitable location for these should be served.

Therefore a careful study should be made both on the ground and er a survey before final decision is made as to whether any tract of nd is suitable and should be selected.

Tree Planting

A golf course without trees would be very monotonous. If it is ecessary to use a tract of land which is bare of any natural growth, the nstruction budget should allow for planting of trees in naturalistic oups to separate the plays on the various fairways, around the backs the greens where they will not cause too much shade, and also in the cinity of tees to give some shade during the hot weather to players aiting.

If property is selected that has a natural growth of trees, careful study of existing growth should be made to keep as many as possible of the long-lived trees, such as oaks, maples and evergreens, and eliminate the short-lived trees, such as birch, soft maples and others of like character.

The planting arrangement of trees and shrubs around the club house site is, of course, always advisable both for improving the setting and screening out any objectionable features, such as the building and area reserved for caddies, parking area, service buildings, etc.

DESIGN AND SELECTION OF HOLES ON GOLF COURSE

In general, there are certain essential features which, subject to conditions of topography, are always considered advisable for any well laid out golf course:

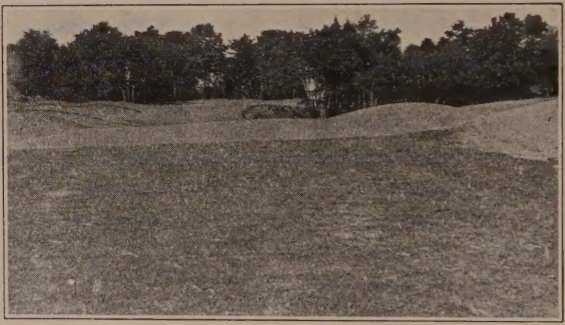

FIG. 1.— TREES FOR BACKGROUND OF GREENS.

(*a*) The course, where possible, should be arranged in two loops of 9 holes for an 18-hole course, and 3 loops for a 27-hole course. Modern standards require that the full eighteen holes should have a length of at least 6,200 to 6,500 yards, and that each nine should start and finish at the club house.

(*b*) The following schedule of holes has been found satisfactory:

Ten holes calling for two long shots to reach the green.
Two holes calling for three shots.
Two holes for a drive and either a pitch or a run-up.
Four holes which can be reached in one shot.

No one should be bound by rules in this matter. All the best courses vary greatly. The point is to get variety.

(*c*) Every hole should have a different character.

(*d*) The course should have beautiful surroundings, and all the artificial features should have so natural an appearance that a stranger would be unable to distinguish them from nature itself.

(*e*) There should be a sufficient number of heroic carries from the tee, but the course should be arranged so that the weaker player, with the loss of a stroke or a portion of a stroke, should always have an alternative route open to him.

(*f*) There should be infinite variety in the strokes required to play the various holes, viz., interesting brassie shots, iron shots, pitch and run-up shots.

(*g*) There should be a complete absence of the annoyance and irritation caused by the necessity of searching for lost balls.

(*h*) The course should be so interesting that even the scratch man would be constantly stimulated to improve his game in attempting shots he has been hitherto unable to play.

(*i*) The course should be so arranged — especially the trapping — that the long handicap player, or even the absolute beginner, should be able to enjoy his round in spite of the fact that he is piling up a big score.

(*j*) Plan to walk toward the tees, so that the course may be extended in case of need merely by putting in back tees. The longest courses these days are approaching 7,000 yards.

(*k*) Holes of quality, providing interesting play and calling for a variety of shots, will make any course popular.

(*l*) The two nines should balance each other in yardage, in interest, and in quality; but the last nine should be the severest as a test of golf.

(*m*) Avoid blind approach and blind short holes. A blind tee shot is excusable, but blind shots of any kind are rarely interesting.

(*n*) Where there is a prevailing wind do not lay out holes on its direct line. Play it as often as possible at an angle.

(*o*) Eliminate as far as possible parallel holes.

(*p*) Do not lay out holes towards the west, especially one-shot holes and those coming in the last nine, as it is very annoying for a player to play a shot with the afternoon sun shining directly in one's eyes.

(*q*) Do not have holes of the same character immediately following each other.

(*r*) See that each hole presents to the player some problem of interest, and that the whole course presents many interesting problems of various kinds.

(*s*) Wherever possible make an easy and secure route to the hole for the poorer players, but lay this out so that an extra stroke will be required in the play.

(*t*) Have as few penal bunkers as possible, only enough, in fact, to protect the quality of the hole.

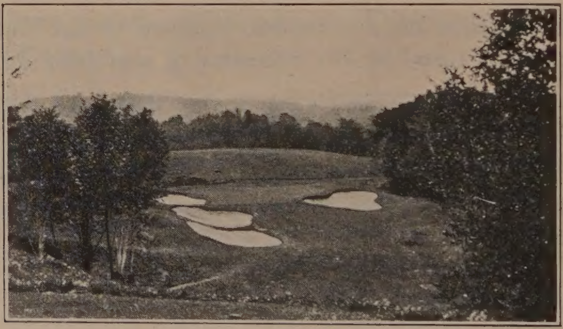

FIG. 2. — VISIBILITY ON SHORT HOLES

Waconah County Club, Dalton, Mass.

(*u*) The hazards should be so placed as to test the best shots of the best players. They should be close to the positions most desirable for those seeking to play the course in par figures. They should be so arranged as to call forth a variety of the best long shots and every variety of approach.

(*v*) When laying out holes of these various lengths, careful attention should be given to the prevailing wind, the slopes of the course, the quality of turf obtainable, and the average amount of rainfall.

ACREAGE

The minimum area usually considered necessary for the layout of a good 18-hole course, with enough land available for club house site and other features, is about 110 to 125 acres. One-half this area would be necessary for nine holes. If it is possible, however, to secure a larger ract, a still more interesting course can usually be laid out and always separated with enough area so that there will never be any danger of players on one hole being hit from shots played on other fairways.

Very often the various fairways can be so placed as to save valuable trees and to avoid ledge or other expensive rock excavation. It is requently less expensive in the end to buy additional land than to try and clear up every acre of that which is available.

Soil Conditions

Golf courses today are continually striving to improve turf conditions. The better the turf on all parts of the course the better the golf course. It is therefore very essential, in selecting the property, to carefully study the soil conditions and have a thorough understanding of the various problems which may be necessary to secure the best results. A well drained subsoil is, of course, the first essential. Plenty of good topsoil should be available for the growing of any of the grasses that are used today on golf courses, especially in the North.

If clay soil conditions are found it is usually necessary carefully to drain the subsoil, otherwise sticky, wet conditions hold up the play on the course in the early spring or late fall. New England is especially fortunate in having — outside of the Cape — probably as good soil conditions as anywhere in this country. In the Middle West clay soil is usually found, and in the South a much lighter soil. In Florida and California it is impossible to grow the northern grasses, and if the best results are to be secured there it is necessary to install a watering system for the entire course. It may be that in the future, if we continue to have the dry summers which we have had the past few years, the majority of the courses in this part of the country will also have to install water systems to keep the turf green on the fairways during the middle of the summer.

Contour of the Ground

The ideal conditions would be a tract having rolling contours with not too many high knolls or hills. The majority of players today greatly dislike a course where there is a lot of hill climbing or side hill playing. Flat land, however, is never considered advisable for a golf course, in that it is almost impossible — without enormous expense — to change the natural surface and make an interesting layout.

When the above conditions have been carefully studied, the next step is the actual placing on the ground of the various holes. The final layout can be determined only by checking over on the ground the natural conditions, and afterwards trying to arrange them on a plan so that the entire layout will fit together. I know of many times when the entire layout has been spoiled by some individual in charge making a selection of one certain hole. I would mention the following points to be considered in laying out the various holes:

1. Nothing is as important as the proper utilization of the topography.

2. Diversity of holes and variety always add to the spice of any golf course.

3. If we could have water hazards, lakes and brooks, fairways through virgin forests, long, rolling, contoured, open country, high plateaus to reach, lovely little valleys to cross with part of course also through sand dune country, we would have an ideal site.

4. Familiarize one's self with the locations of natural features, and the best location of greens, with directions of play to them.

5. Do not spoil layout by attempting to save certain feature holes.

6. Study utilization of topography from standpoint of good tee shots, green, trap and bunker location and selection of playing area giving visible shots.

7. Study utilization of natural hazards. These are many times better than artificial hazards.

8. Study arrangement of trees for sides of fairways and around greens, views or vistas from various points on course. Trees too close for shade. Trees make poor hazards.

9. After the holes are tentatively located be sure that the layout is fundamentally correct, and that if it is impossible to carry out all construction in the beginning, the holes are so designed that improvements can be added from time to time. There are many courses today on which there could have been saved thousands of dollars if the initial layout had been properly studied and carefully laid out.

Details of Construction

1. *Tees.* — Tees are usually the least expensive item of construction on any golf course, and it is therefore considered advisable to have a large enough area to allow for changing the markers so that the turf on these tees will have a chance to recuperate after several days of hard usage. A great variety in the length of holes can be obtained by building several sets of tees. Elasticity in the length of holes is always necessary, due to the soil and turf conditions in the wet spring and late fall and the dry summer months. It is much better to make these areas

conform as closely to the natural contour of the ground as possible, ather than build them up in the old-fashioned way, which is always hard to maintain.

2. *Fairways.* — These areas vary in width according to the location of the shot which is supposed to be played to or from same. These areas usually start 75 to 100 yards from the tee, and are much narrower at the tee end than at the landing space or the 200-yard mark. A width of 175 to 180 feet is considered a fair width at the 200-yard mark. From then on to the green the fairways narrow in to a width of 100 to 125 feet at the green itself. It is never considered advisable to have straight lines on these fairways, but rather have the sides follow an irregular line, such as the contour of the ground, or as may be determined by the location of trees, traps, mounds or other features.

3. *Rough.* — The area called "rough" on a golf course is that located between the tee and the fairway, and usually includes a 10 to 20 yard strip along the sides of the fairway that is so cleared up that a player can always find a lost ball. Individual trees may be left in this area, or large boulders or ledge if they are covered with a sufficient growth of turf to enable a player to play from them.

4. *Greens.* — The modern green of today varies greatly in size, contour and shape according to topographical conditions and the shot which is to be played to it. It is generally considered advisable to have a finished putting surface, according to the various types of holes, from 4,500 to 8,000 square feet. Some greens are long and narrow, some are wide and shallow; in fact, there is no special shape or size that can be standardized.

Greens should be so constructed that a player, providing he makes a proper shot, should always have a full view of the entire surface if possible, or at least be able to see the flag on the green. It is much more attractive to play a shot to a green which is backed by beautiful trees rather than a green that is wide open with no background at all. The surface of the green should be designed so that there is always proper surface drainage. Sometimes the surface can be drained toward the front, and other times at the side, but, generally speaking, it is not considered advisable to pitch the green from the front to the back, or, in other words, have the back of the green lower than the front.

Long slopes, with easy grades on the side of the greens which are in turf, are much easier to maintain than the old-fashioned railroad embankment type of construction.

5. *Traps and Mounds.* — These features are usually placed to penalize a poorly played shot either on the fairway or to the green.

Fairway traps are usually placed along the side of the fairways to penalize the long, wild player who is off line, rather than the short player, or one who goes straight down the course. Diagonal traps are often placed, especially on dog-leg holes, to force the player either to play the shot according to his ability, or else play out around, and thereby have to play a much longer shot to the green.

Fairway traps are often placed short of the green, sometimes in the center of the fairway, to penalize a poorly played second shot or penalize the player who tops or misses his drive. These traps are always placed, and should be carefully studied according to the type of the hole which is laid out. Blind traps are in the same class as any other blind hole, and are not considered advisable. The sand in the traps should be carried well up on the contour of the face of the trap, so that it will be plainly visible from the point of the fairway from which this shot is supposed to be played. The traps around the greens are placed according to the length of the hole and the severity with which the player should be penalized. It is always more interesting to make the outline of all traps irregular, or naturalistic, in shape if possible. The natural effect obtained and seen in the sand dunes of the Cape or other areas along both seaboards of this country is the best example of naturalistic traps, and should be carefully studied if one is to secure the best results in the designing of these features.

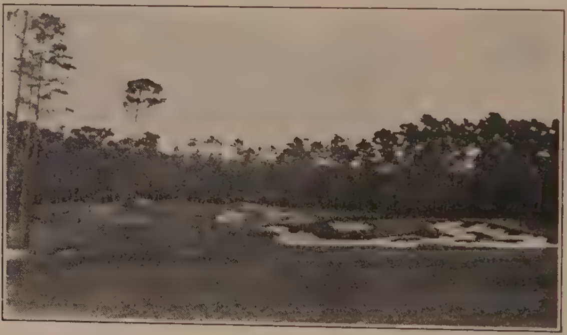

FIG. 3. — VISIBLE TRAPPING

Pebble Beach Country Club, California

6. *Turf Mounds.* — Turf mounds on the golf course are usually placed or built to cover up large rock areas, or, if the contour of the ground is too flat to break up this condition, hollows and mounds can be built on any flat piece of land at considerable expense and thus change

he entire character of the ground. This is not usually necessary in his part of the country, but it is often found advisable in building ourses, especially in the Middle West.

Water Hazards

Brooks and natural or artificial ponds are always interesting on any olf course because they add to the landscape effect and also introduce a ifferent type of hazard than is possible with a course which has only and traps. These ponds are often useful in other ways because they nay serve as a water supply, at least for watering the course, and thereby liminate the expense of using city or town water. In many clubs the se of these ponds for skating adds also another feature.

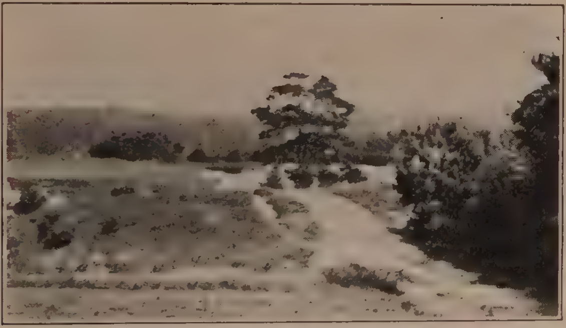

Fig. 4. — Natural Hazards

Pine Valley Country Club, Philadelphia

Construction of Course

There are several methods of construction used in building golf ourses, namely, by day work or the straight contract method.

We firmly believe that no golf course should ever be built by conract, in that it is almost impossible to draw up specifications and details hich would not be subject to some change as the course was being uilt. The building of a golf course is like the painting of a picture, that as the course is built features are always added or changed entirely ntil the final results are secured. If built under the contract method ny changes are always expensive and add greatly to the cost, outside f the friction between the architect, owner and the contractor.

The first step in building any golf course is the clearing of the land y the removal of trees, brush, roots, rock or ledge which might interfere with the preparation of the soil for seed conditions. If drainage is necessary, a careful study should be made of all conditions and necessary sizes and types of drain pipe layout so that the course will be dry at all times in the playing season.

After the ground has been properly cleared the construction of the tees, greens, traps and other details follows. Many times, the size of the traps is determined according to the amount of material needed for the grading of greens and mounds on other areas where fill is required. Generally, the material from the traps around the greens will furnish sufficient fill for the contouring and topsoiling.

After all construction has been completed there are two periods in the year, in New England, when seeding can be done to the best advantage. Fall seeding usually secures better results than spring seeding, unless this can be done before the 1st to the 10th of June, or in time enough to allow the seed to secure a good start before the hot summer weather arrives.

In the South and on each coast, where Bermuda grass is used, the seeding is done during the summer months in the rainy season. The time for seeding varies in the North according to the weather conditions and location of the property, but is usually carried out during the latter part of August or the first part of September.

Equipment for Construction of Course

In all construction work today the use of proper equipment is considered essential if cost figures are used. The majority of the work on the golf course is usually done with tractors. The caterpillar type will do a great deal more work in the pulling of trees or removing of rock. The plowing, harrowing, rolling and other similar work can be done with the Fordson type. Various kinds of equipment are needed for the economical moving of earth. The large Baker Maney Scraper attached to a 5-ton tractor will very economically move material, if the distance is not too far. Steam or gasoline shovels with trucks are used a great deal in the construction of golf courses. If ponds are to be provided the dragline type of shovel will also be economical. The rough construction of the traps, and even the subgrading of the greens, can well be done with an experienced operator on the shovel, but there are still some cases where horses and scrapers will place the material to much better advantage, especially as the green nears the finished grade.

Water System

In order to keep the texture of the turf on the greens in proper shape a sufficient supply of water is essential. A proper layout and installation of a water system is always necessary before any seeding on the golf course is attempted.

Labor

Probably the largest expense in the construction of any golf course is for labor. For rough work experienced men are not needed, except that the best results are always obtained by using an experienced pick and shovel man. The construction crew on any golf course should have several experienced graders, as otherwise a great deal of time and money is lost by trying to teach inexperienced men the details of this work. If a course is to be built near the center of population, usually plenty of local labor can be obtained, but if built away from this source, a construction camp on the job is considered advisable.

The construction superintendent in actual charge of the work should be an experienced man with a thorough understanding of all details, as otherwise the expense of the finished course will be much greater. This man must have a thorough understanding and knowledge of all the work in the beginning, as it is only by the proper placing of material that the best results are obtained.

Cost

1. *Cost Estimate.* — In our office cost figures have been kept for the past nine or ten years on all the courses which have been built under our direction. These are very useful in determining in advance or making up the financial budget for every item of expense that may enter into the construction of the course from the time it is started to the time it is completed. With these facts before the officials it is possible to eliminate certain features, such as fairway traps, additional tees, and sometimes final construction of green sites, all of which can be added at some future date without disturbing the fundamentally correct layout.

The cost of building a good golf course is usually the first question asked after an inspection of a site. There is only one way properly to answer such a question, and that is to check over every detail or item of work that may be necessary to complete a course on whatever property may be selected. One of the largest expenses in the construction of any course is probably the removal of rock or trees, which may vary a great deal, especially in New England and some of the eastern states. The average cost of an 18-hole golf course in New England varies from a minimum of $40,000 to a maximum of $150,000 to $200,000. By the total cost I mean the cost of all labor and equipment expense necessary for clearing and preparation of the ground, ready for seeding plus the cost of seed and fertilizer, and suitable water system for the entire course.

In the South the average cost of an 18-hole golf course would run from $35,000 to $100,000, and in the Middle West the average cost would run between $40,000 and $125,000. The main variation in this expense is due to moving of earth to create artificial mounds and hills and elevated greens.

LANDSCAPE FEATURES OF GOLF COURSES AND SURROUNDING COMMUNITIES

By Arthur A. Shurcliff*

(Presented at a meeting of the Boston Society of Civil Engineers, December 17, 1930)

It is interesting to consider what our grandfathers had for pastimes. Of course, they had no golf course to spend their time on, so they exercised themselves with the cows and the gentle work of the farm. I suppose the spectacle we present today with our enormous golf courses, which do not even raise hay, would be a sad disappointment to them. We can picture for ourselves the type of house, built about one hundred years ago, having a very ingenious arrangement of the living and work rooms, with the addition of the barn, and finally the yard where the poultry lived, and an arrangement for the cows.

At a period, say, fifty years later, people were enjoying themselves, perhaps in lighter forms of exercise, such as croquet. If that was not strenuous enough they climbed a mountain, as for example, Mount Chocorua in New Hampshire, near the top of which they might stop at the cabin on the cliff and have something to eat. The middle aged people traveled on horseback, but today you will not find the middle aged people going up even on horses. At present the people who climb mountains are chiefly clubs of young boys and girls going by the hundreds, and at an enormously high rate of speed.

Recreation at that time included such a pastime as canoeing on the waters of the Charles River, stirring up mud and snapping turtles. That interesting epoch is now passed, and today this same type of enthusiastic young people is engaged in running Ford cars. After dinner our wives and children say, "Now we must get into the Ford, and probably before night we can make 175 miles."

Today people at Hollywood pack themselves into an enormous amphitheatre. At another place 86,000 people crowd into a huge bowl to watch 22 people disport themselves. It is, of course, the Yale Bowl.

Again we may visit an enormous field in Detroit, where there are great ball diamonds, one right after the other. There are opportunities for football, baseball, tennis and all the pastimes of the modern community. There is no farming done there, no plowing or harrowing. Everybody is batting balls around.

---

* Landscape Architect, 11 Beacon Street, Boston.

We may consider locations nearer home, such as the central portion of the Charles River Basin, where steps are being taken to provide conditions so that more pleasure can be had. Also there is Columbus Park, created by the city of Boston, with a new beach where tens of thousands of people can enjoy themselves. Near that, also, is the end of South Boston which has been arranged for recreation purposes, with a lovely pier and the old fort which once meant human discord, but now means human amity. It is worth one's while to see that amazing fort, with the romance that went with the smell of burning gunpowder.

Consider, now, the great modern pastime, — the game of golf. If one has an opportunity to own a large piece of land, a part of it can be utilized for a golf course. Of course, the obvious thing, as Mr. Stiles has said in his paper on "Golf Course Design and Construction," is to arrange for a community of private homes adjacent to the course. There are two general ways to do this: one is to have a road bordering the course which will give access to the fronts of the houses which are on the outside; the other layout is to have the living side of the house facing the course and the roads on the exterior. Both systems have advantages and disadvantages. In the latter case, one would go through the house into the garden, then through the grove into the golf course. These houses could be made attractive with pleasing arrangement of planted grounds and a driveway winding around in graceful curves and giving access to the golf course.

Other features of such a development require consideration, such as the orientation of the living and service rooms of the houses, which may be influenced by advantages of one or the other of the points of the compass, the prevailing winds, and whether the family intends the home only for summer use, preferring to have the living rooms with a cool northern exposure, or whether they prefer southern exposure for the all-year-round home. In all cases of this type of development, views from the houses would be interesting, and yet sufficient privacy would be afforded by natural or planted tree growths and gardens.

A community may be laid out as a modern town with houses on dead end streets, with the exception of certain main through streets. Such a layout insures freedom from continuous annoyance of motor traffic. With intervening space there could be provided paths leading from one group of houses to another, with general areas of green fields and sunlight, and not far away may be the golf course.

We can picture a house with a garden enclosed by a wall beyond which may be a wilderness of woods, or a pond with water lilies, or a region with flying golf balls. Some people love a golf course and some do not. For some the image of a young paradise is a place where one can live with the motor on one side and a golf course on the other.

The layout of a country club should provide adequately for parking of motors, for the club house with its various recreation rooms, for service buildings and for the tennis courts and other outdoor recreation features. These should all be planned together, because if one or two of these buildings are in the wrong place, discredit will be brought upon the club, and the expenses be unusually high.

As a means of studying the most desirable solution of a landscape problem I have often found recourse to models a great help, not only for my own satisfaction, but also as probably the safest argument to adopt in an attempt to persuade a person that the thing he thinks he wants will not look like his imagination of it. For example, an arch bridge was desired across a small stream and it was to be built of stone. At a time when the stream was frozen over a rough framework was erected on the ice, and a painted canvas elevation of the bridge attached to it of the suggested design. A study of this in its surroundings indicated to all parties that certain details could be improved, and the final design was determined upon, and this proved satisfactory to all concerned.

Many times the location of driveways can be studied on the ground by setting stakes so that the serviceability of a road for vehicles is not only satisfactory, but its attractiveness from the point of view of landscape features when observed from certain positions is assured.

The location, height and detail of garden walls and openings may often be studied by use of cloth on framework, in order to demonstrate whether a wall of assumed proportions will mar attractive vistas, or will afford the desired seclusion without detracting from other interesting features of a well-designed layout.

FACTS *v.* GUESSWORK IN HIGHWAY TRAFFIC CONTROL

By Maxwell Halsey*

Whenever life and time have been at stake in the past, resort has been made to facts. No one would think of guessing at the strength of a cable that held up an elevator or a suspension bridge. The risk would be too great. In factory production the study of facts showed that the belt-conveying system could save much time by keeping the product in almost continuous motion during the assembly process. And yet for years the traffic problem, resulting in the death of thousands and the loss of millions of dollars in delay, was handled upon the basis of guesswork and political principles.

Street and highway traffic has grown rapidly, particularly since the introduction of the automobile. The accidents and delay which have resulted have increased at an even greater rate. The reason for this disproportionate increase in accidents and delay has been due largely to the failure of street and highway design and control to keep up with the advancement of personal transportation units, both in number and speed. This marked lag of remedial measures behind the development of the problem has resulted in thousands of fatalities and loss of time estimated at millions of dollars.

It has been only within comparatively recent years that engineering methods have been used to attack this problem. As the problem has grown from centers of large cities to the smaller communities, and even out along the main trunk lines connecting them, the engineering attack has followed. I shall give a brief outline of this work and indicate a few samples where facts have supplanted fiction.

Necessity for State Control

The expansion of motoring habits to a point where the average trip usually carries the motorist through several municipalities has made State control absolutely necessary. Since it is obviously impossible to expect motorists to learn different systems of traffic regulation for each political jurisdiction through which they pass, uniformity is necessary. The expansion of the traffic problem from the larger cities to the smaller communities, and even along the trunk lines connecting them, has made necessary co-ordination of traffic planning and control within adjacent communities. No longer can each political jurisdiction plan its streets or control its traffic without giving serious consideration to those about it.

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The need for uniformity and co-ordination in traffic matters has long been felt, but only during recent years have steps been taken to provide the instrumental organizations necessary to bring them about. The national attempts toward uniformity have been very successful and have provided standards, but something more than standards and the knowledge of correct practice is needed to effect the desired results. It takes organization and constant effort to overcome the inertia of past practice and to provide the adoption of uniformity. The delay in establishing these organizations is due partly to the fact that the local communities are jealous of their prerogatives, and partly to the fact that there existed no adequate precedent. A beginning has been made, however, and it is believed that there will be a general movement in this direction.

PROPER SCOPE OF STATE CONTROL

In establishing State control one of the most important problems is the determination of its proper scope. To cover too much ground will result in antagonizing the local communities, and the purpose of the work will be defeated. But unless sufficient ground is covered, samples of non-uniformity will remain to be pointed out by rebellious municipalities. Somewhere between these two extremes a compromise must be effected which will go far enough to bring results but not far enough to lessen co-operation.

What Needs Supervision. — Traffic regulations are the first subject to need supervision. These must be uniform, as they affect the motorist. Local authorities must be allowed freedom in handling their problems to suit themselves, and yet must be required to employ rules and regulations which are uniform. A supervisory agency would not require that a street be a one-way street, but if it were so designated by the community the agency would require that *all* vehicles go one way, and possibly that the regulation should apply twenty-four hours a day.

Traffic devices should next be given supervisory attention. The motorists from all parts of the State need to be protected from non-uniform and improperly operated devices. Traffic signals should be required to operate in accordance with good standards. Minimum standards may even be established so that motorists need not be annoyed by unnecessary signals. Through ways must be used correctly if they are to be of value, and therefore should also come under supervision. The same thing is true to a greater or lesser degree of beacons, islands, signs and markings. The supervising agency should not be primarily interested in whether or not a device is used, but in the correct and uniform operation of it, if it is used. Such an attitude is negative, not positive. To adopt a positive attitude would be to give the local community the impression that the State is trying to manage its affairs. Through traffic should also receive the protection of State supervision. The local community is primarily interested in its own traffic. It will often severely penalize the through traffic if it believes it is promoting local business or safety. The State should protect these through traffic interests.

Desirable Limitations upon State's Authority. — There are certain limitations upon the authority of the State which are desirable. The State should be placed in a strictly supervisory position. Its written approval should be required, but no more. It should not be empowered to force the towns to make regulations or to install traffic signals. Its strength, even upon its approvals, should be negative. The law should merely state that the subjects required to be approved have no legal effect unless they have been approved in writing. Unless these restrictions are provided, a centralization agency might quite easily become overbearing, and might soon inspire sufficient antagonism to nullify its efforts.

Provision for Assistance to Local Communities

The centralizing agency should be in a position to assist the local communities in their traffic problems. This, however, should be done only at their written request. The first way in which the agency can aid the communities is by serving as a clearing house. As each city or town is faced with a particular traffic problem, and solves it, a record of it should be filed. With this material for reference there is no reason why other cities and towns should make the same mistake.

The second way in which the centralizing agency can assist the local communities is by developing a fund of technical information. This can be obtained by gathering a library and by carrying on research work. This information should be available to all the cities and towns, and should assist them in solving their problems.

The third way in which the centralizing agency can be of assistance is by going to the city or town and solving its particular problem. This should be done only upon written request, and the towns should be encouraged and instructed to make their own studies.

Methods of Providing State Control

Having decided upon the proper scope of State traffic control, it is necessary to consider the various methods of setting up such an organization and of vesting it with the proper authority.

There are several methods of providing State control. One method is to hold a series of district conferences, to be attended by all the local traffic authorities. At these meetings uniformity and correct procedure would be determined upon, and by mutual agreement put into effect. Under this system each local authority would be taking an equal part in the movement. Its success would depend entirely upon moral suasion and co-operation.

Another method is that of direct legislation. This might take several forms. Attempts might be made, as they have been in some places, to incorporate the terms of uniformity and correct practice into the law itself. This method, however, is apt to be too inflexible. There is too much delay and insecurity involved in waiting for the Legislature to bring such matters up to date.

Another form of the direct legislation method would be the establishment by law of a separate and independent traffic commission vested with all the necessary powers. Such a method has merit and will undoubtedly be tried out in some States. This type of control is now in existence in New Jersey.

A third form of the direct legislation method is that which is being used in Massachusetts. Under this method an existing department of the State has been placed in a supervisory position and vested with the necessary powers. This method has many advantages and will probably become the predominating type. Some of its advantages are as follows:

1. It disturbs the existing organization less than any other method.
2. It makes available much of the State's existing organization for the construction and maintenance of highways, including the project engineer, the construction engineer, the maintenance engineer, and the bridge engineer, etc., as well as the contacts all over the State of the State district engineers.
3. Being an integral part of the State's organization it can better serve the State's own highway traffic problem.

4. Its contact with the local communities is strengthened because of the old relationship already established between the cities and towns and the State departments.

Further details of this method will be given when the Massachusetts State control is discussed a little later.

Personnel Requirements

There are two distinct sets of personnel which will be required for State control. The first is that which constitutes the central office. This force should be composed of a traffic engineer and sufficient assistants to relieve him from the bulk of detail. Particularly at first the traffic engineer's work will be largely sales and administrative. His assistants should be grouped functionally to cover applications and approvals, accidents, statistics and research.

The second group of personnel includes those who are to cover the different parts of the State. These district engineers should have an area which they are capable of covering in a day. Otherwise the delays and lack of frequent contacts will decrease the efficiency of their work. It is not feasible in a large State to attempt to carry out State control without assistance of district men.

Initiating State Control

In order that those who are establishing State control may start correctly and may have an accurate picture of the problem, a survey of traffic conditions should be undertaken. This survey should serve many purposes. It should provide sufficient facts to guide the agency in the first steps to be taken. It should place the central agency in a superior position, first, by placing in its hands more facts than are possessed by the local communities, and second, by creating a very definite impression of the factual manner in which the State control is to be handled.

It is suggested that the scope of this survey be wide. Sufficient information on regulations, signals, signs, etc., may be gathered by the questionnaire method, supplemented where necessary by personal interviews. Some of the characteristics of traffic using the trunk lines should then be obtained. Sufficient counts to make possible a flow map of trunk lines should be taken. The speed characteristics of the more important of these routes should be ascertained. The accident records of the outlying highways should be gathered.

Immediately following the survey, and as a result of its findings, these problems should be taken up with the local communities. The facts in the case should be placed in their hands, the law explained, and their full co-operation solicited. Upon the first contact much of the success of the State control will depend.

From the materials which have been gathered in the survey, and from the different reports upon uniformity and good practice, a series of codes should be prepared. These will serve as measuring devices in making approvals, and will assist the local communities in their problems.

Operation of State Control

Having provided the mechanism of State control, and having initiated it, its operation should cover the following matters:

Application for approval should be introduced in the districts.

The local communities should be encouraged to use the local district offices and to rely on the central office only in cases requiring unusual considerations or those involving disagreement.

All operations should be based upon factual material. All requests for applications should be accompanied by the necessary facts. If a traffic signal is required because of traffic volume, a count establishing this volume should be provided. If it is required because of accidents, then the accident records and analysis should be provided. This serves to place the burden of proof upon the local community, and at the same time to encourage them to substitute facts for guesswork.

Bulletins setting up the standards required by the centralizing agency and indicating the best practice should be issued and kept up to date. The field of traffic engineering is so new that the local communities frequently do not know what is the best thing to do. The provision of materials to guide them will do more to further State control than any other single factor. Municipal administrators will usually follow the path of least resistance, and if the correct control methods are presented to them in printed form it will be easier for them to follow.

A constant check should be kept upon conditions. This will serve to forestall any attempts to get away from uniformity, and will indicate the sincere interest of the controlling agency. Once a solution to a problem is provided, it should be checked and facts gathered to show what the effect has been.

In its initial stages the controlling agency should be lenient in the changes which it requires. Equipment which will soon be worn out should be given a short time before it is required to be replaced, unless it constitutes a dangerous hazard. The actual cost of replacement should be considered, for many of the smaller communities may have difficulty in providing the necessary funds.

PITFALLS TO BE AVOIDED

The most serious difficulty to avoid is the opposition aroused by a local feeling of "home rule." In many parts of the country the local communities are very jealous of their prerogatives, and are apt to resent any encroachment upon them by the State.

The attitude which the supervisory agency must take and must make clear to them is this: the State is not interested in running the local affairs of the city or town. Its interest is in the motorists of the State as a whole. The motorists should be controlled in a uniform manner throughout the State, and should not be subject to hazard or unnecessary delay. The State is in a strictly supervisory position. It is not its intent to take a positive stand and force the local communities to do or not to do specific things. It merely wants to be sure that what they do is uniform and in accordance with good practice. If this point of view can be put over no difficulty will be had.

Another problem which may be encountered is that of dealing with the proper authorities. The contacts should always be directly with the governmental officials and not with chambers of commerce, boards of trade or social organizations whose interests or opinions may be contrary to those of the men the community has elected to handle their affairs. Nothing can cause more hard feeling than for the State to be placed in the position of having taken sides with any particular group on a controversial subject.

Care should also be taken to deal directly with the proper traffic authority. If none has been appointed the local community should be urged to appoint one. Great divergence of opinion will frequently be found within the governmental agency itself, and again the State should not be put in the position of taking sides.

The full responsibility for facts should be placed upon the local communities. These must be obtained before intelligent approvals can be given. They should be kept afterwards in order that complete examples may be established, and that the local officials may receive as much credit as possible.

Whenever an application is made for a particular device it should not be refused unless a suitable substitute can be suggested, otherwise the State may be accused of being against safety.

Problems and their solution should be followed through, and any success clearly pointed out. This will establish the correctness of the solution.

The State should set a good example by using the best possible control upon its own highways, and by taking the lead in traffic matters it will automatically be imitated and looked to for advice.

State Control in Massachusetts

In 1928 the General Court of Massachusetts, realizing that the State traffic problem was becoming critical, and that uniformity was essential, passed chapter 357, Acts of 1928, entitled "An Act Providing for Uniform Traffic Signs, Lights, Markings, Signal Systems and Regulations," under which the Department of Public Works was placed in a supervisory position in regard to these matters.

Purposes of the Act. — There were three main purposes of the act: first, the elimination of confusion to the motoring public through the accomplishment of a basic uniformity in the signs, signals and traffic control devices used by the Commonwealth and by the cities and towns; second, the maximum safety and facility of through traffic movements upon State highway routes lying within the corporate limits of cities and towns, (*a*) by preventing unnecessary obstruction of such routes by improperly placed and operated control devices, and (*b*) by protecting such through routes from dangerous interference from cross traffic by application, where necessary, of the "boulevard stop" rule; and third, the creation of a responsible traffic engineering agency in the Department of Public Works, capable of co-operating with the local officials in developing safe and uniform methods of traffic control and administration.

Personnel of the Traffic Engineering Office. — At the present time the personnel is composed of a traffic engineer, one chief assistant, one accident statistician and analyst, one statistician, and two engineers used chiefly in special studies. The office also has one secretary and two assistants, and one draughtsman. In addition to the main office force there exists in each of the seven maintenance districts throughout the State a traffic engineer who spends his whole time upon this subject. The above represent the permanent employees, and any special work that is to be done is accomplished by the addition of temporary workers. These latter are recruited locally by the district offices.

State-wide Survey. — In order to carry out the purposes of the act, a comprehensive State-wide survey was made. This gave a picture of present conditions.

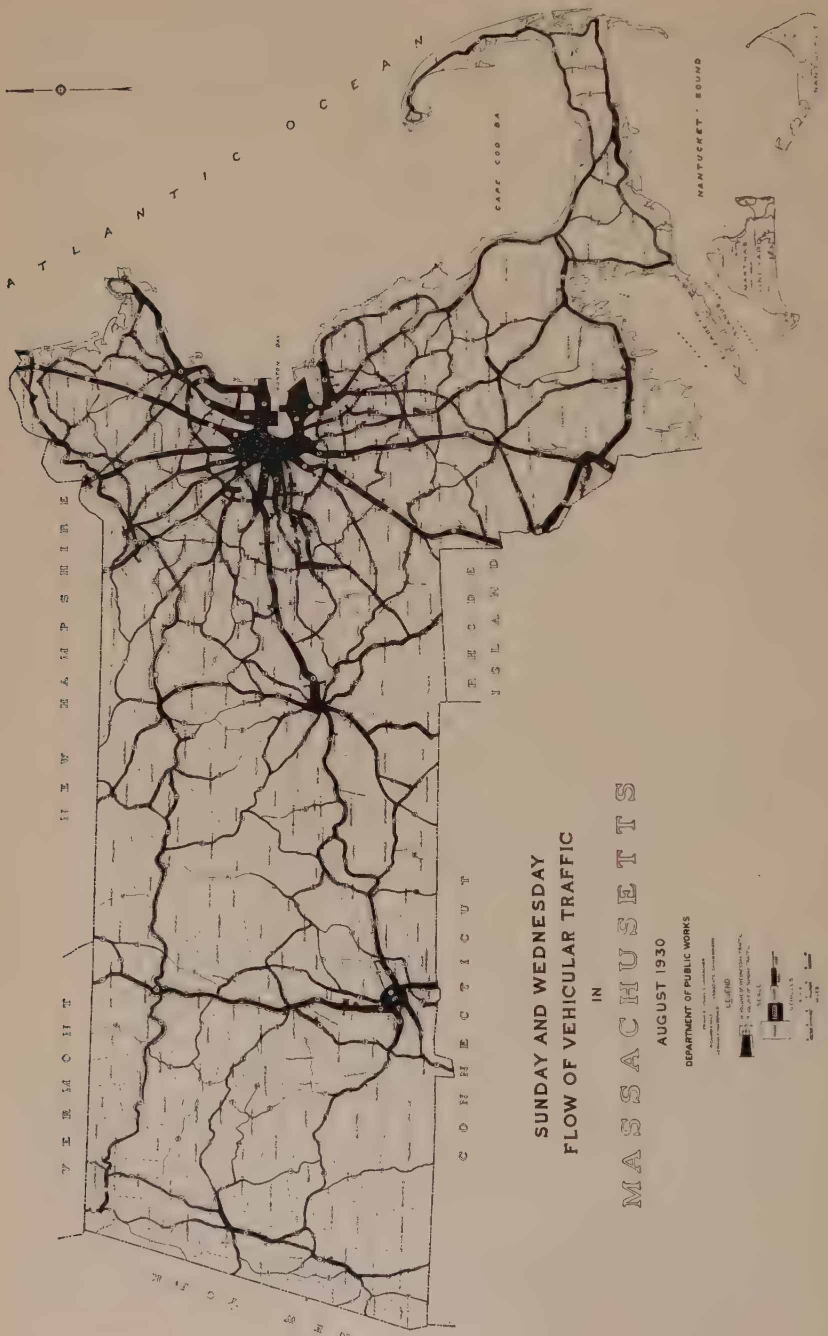

ATLANTIC OCEAN
BOSTON BAY
CAPE COD BAY
NANTUCKET SOUND
MARTHAS VINEYARD
NANTUCKET
NEW HAMPSHIRE
RHODE ISLAND
CONNECTICUT
VERMONT
NEW YORK
SUNDAY AND WEDNESDAY
FLOW OF VEHICULAR TRAFFIC
IN
MASSACHUSETTS
AUGUST 1930
DEPARTMENT OF PUBLIC WORKS
LEGEND
SCALE

Fig. 1

Bulletins Establishing Standards. — As a means of facilitating the business of making the written approvals, required by law, and to assist the local authorities, the Department has prepared a series of bulletins covering signals, signs, beacons, markings and islands.

Co-operation. — The Department has met with thorough co-operation on the part of all cities and towns, and it is anticipated that the general results will indicate a material reduction in accidents and congestion.

FUTURE OF STATE CONTROL

It is believed that State control of traffic is not only desirable but inevitable in all the States. The area of control must keep up with the area of influence. The influence of the automobile has certainly outgrown the municipality. Regional or interstate control is not far distant, particularly regarding those States which are small and compact, and which are naturally connected by geographical factors.

As accidents and congestion increase, the economic losses which result will continue to grow. These losses will attract constant attention, and the work of traffic engineers will be increasingly recognized. The traffic engineering agencies established in Boston, Chicago, Detroit, Philadelphia, Pittsburg, Providence, St. Louis, San Francisco, Seattle and Washington, D. C., are evidence of the city movement. The traffic department of Essex County, New Jersey, is evidence of the country movement. The Massachusetts traffic engineering activity, as well as that of New Jersey, indicates the beginning of State control.

All those who are feeling the cost of accidents and congestion will eventually resort to traffic engineering. This will undoubtedly include all the transportation interests, the insurance interests, and many others.

Undoubtedly there is no field where the effort invested can bring more valuable returns. Public safety and public convenience are of tremendous importance, and each succeeding year will find greater expenditures toward their relief.

Some of the factual studies which have been made as a result of the State traffic engineering activity in Massachusetts will serve to indicate what may be accomplished by the engineering approach.

THE USE OF EACH HIGHWAY

The most important single factor regarding a stretch of highway is its use. How many vehicles use it, when do they use it, and what kind of vehicles are they? These facts indicate the relative importance of each highway. They determine the projecting of future highways.

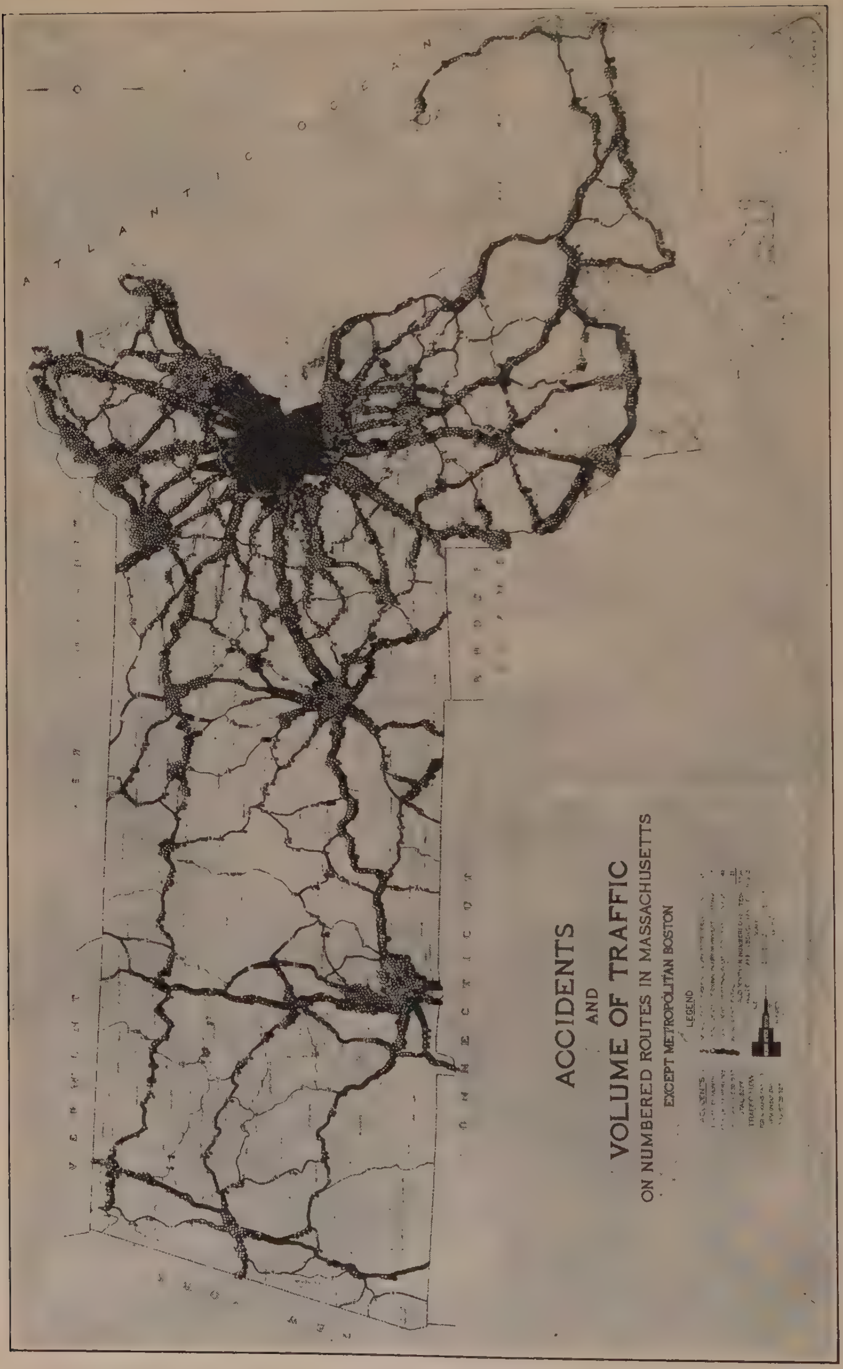

ATLANTIC OCEAN
NEW HAMPSHIRE
VERMONT
NEW YORK
RHODE ISLAND
CONNECTICUT
ACCIDENTS
AND
VOLUME OF TRAFFIC
ON NUMBERED ROUTES IN MASSACHUSETTS
EXCEPT METROPOLITAN BOSTON
LEGEND
ACCIDENTS
TRAFFIC

FIG. 2

They indicate the type of construction which should be used. They also indicate where there exists the greatest demand for maintenance, snow removal, etc. Their greatest value, however, comes in their use in determining the safest and most efficient method of traffic control. Increased recognition is being given every day to the fact that it is just as important to provide adequate control for traffic using the highway as it is to project, construct or maintain the highway.

Attention is called to Fig. 1, which shows the flow of vehicular traffic upon Sunday and Wednesday over the numbered highway system in Massachusetts. This flow map shows at a glance the relative importance of each highway. It shows the importance of the metropolitan centers, the effect of the recreational centers, and the very decided increase of traffic upon Sunday. The width of band of each numbered route indicates graphically the number of vehicles which passed from 7 A.M. to 11 P.M., the wider the band the greater the number of vehicles. Ever since 1909 the Department has taken a traffic count every three years. Beginning in 1929 the counts have been and will be taken each year in such a manner as to show the flow characteristics of each numbered route.

LOCATION OF AUTOMOBILE ACCIDENTS UPON NUMBERED ROUTES

Attention is called to Fig. 2 which shows the exact location of 3,704 motor vehicle accidents which occurred upon the State numbered routes during the seven months' period ending July 1, 1930, Metropolitan Boston excepted. In addition, there were 14,573 accidents, not shown on this map, which occurred within the cities and towns, but not shown upon the numbered routes. This total of 18,277 accidents reported to the Registry of Motor Vehicles by persons involved in accidents, by registry inspectors, and by State and local police are filed by location in the traffic engineering office of the Department of Public Works. This small map is but a miniature of a large-scale spot map measuring 9 by 18 feet which is maintained by the Department, and upon which all accidents are shown within 100 feet of the exact place where they occurred. Each small white tack indicates one accident involving personal injury or property damage. Each large white tack indicates three to five of such accidents occurring within 100 feet of the same point. Each large black tack indicates five to ten of such accidents occurring within 100 feet of the same point. Each large red tack indicates an accident involving the death of at least one person.

The relationship between the number of vehicles using a route and the number of accidents upon that route is very important. Heavy routes with few accidents indicate safe operation, while lightly traveled routes with many accidents show hazardous operation. Special studies are being conducted at present, and when plotted in relation to the above will provide most important factors involved in accident study.

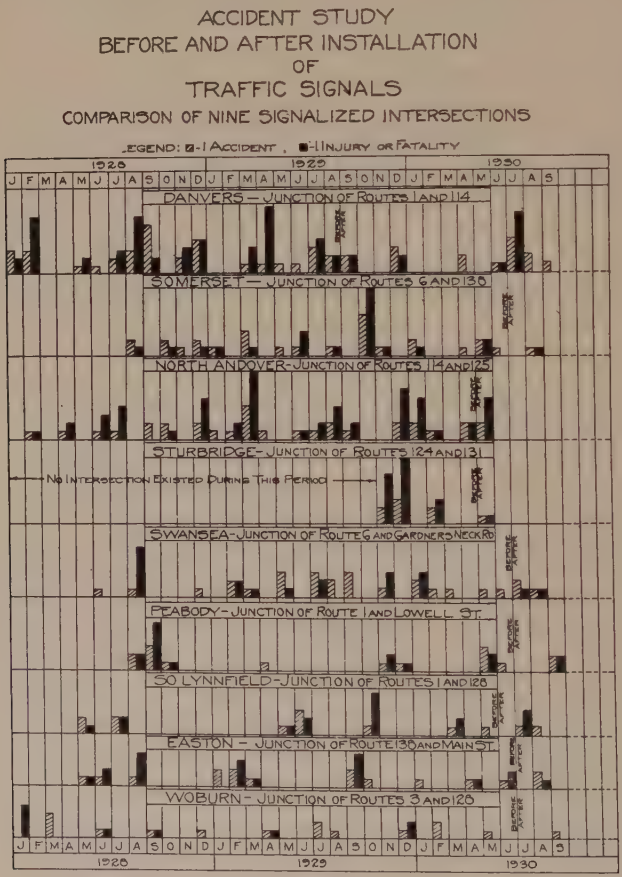


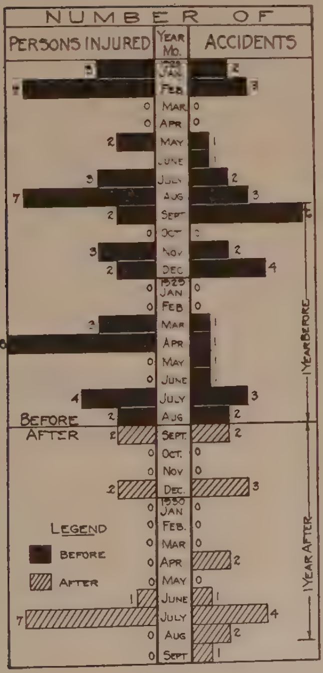
FIG. 3

ACCIDENT STUDY BEFORE AND AFTER INSTALLATION OF TRAFFIC SIGNALS

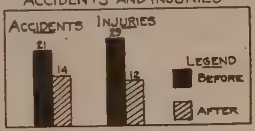
The Department of Public Works installed its first traffic control signal on September 2, 1929, at the junction of routes 1 (Newburyport Turnpike) and 114, locally known as Pope's Corner, Danvers. The installation was made as a last resort, and was located at Pope's Corner because that intersection had one of the worst accident records in the State.

Accident Report before Signal Installation. — An analysis of the accidents occurring at this intersection during a twenty-month period prior to the installation of traffic control signals showed that 33 accidents had occurred and that 46 persons were injured. The intersection had good visibility and motorists were warned of its hazard by four flashing beacons in addition to stop signs upon the lesser important streets. (See Figs. 3 and 4.)

ACCIDENT STUDY
BEFORE AND AFTER INSTALLATION
OF TRAFFIC SIGNALS
AT
INTERSECTION OF ROUTES 1 & 114



YEARLY REDUCTION OF ACCIDENTS AND INJURIES



CLASSIFICATION OF ACCIDENTS AND INJURIES

ACCIDENTS 1 YEAR				INJURIES 1 YEAR		
BEFORE	AFTER	CHANGE		BEFORE	AFTER	CHANGE
11	1	-10	CROSS MOVEMENT	15	0	-15
1	0	-1	HEAD ON	1	0	-1
9	11	+2	UNKNOWN	4	9	+5
0	2	+2	REAR END	0	3	+3
21	14	-7	TOTAL	24	12	-12

FLOW OF VEHICULAR TRAFFIC

AVERAGE DAILY FLOW	1929	1930
16 HOURS	11,772	14,123
VEHICLES PER HOUR	735	884
% INCREASE	20.0%	

RELATION OF MONTHS — ACCIDENTS — INJURIES

RATES — 20 MONTHS BEFORE 13 MONTHS AFTER	BEFORE	AFTER	REDUCTION
AVERAGE NUMBER OF ACCIDENTS PER MONTH	1.65	1.17	-0.48
AVERAGE NUMBER OF INJURIES PER MONTH	2.30	1.00	-1.30
NUMBER OF INJURIES PER ACCIDENT	1.14	0.86	-0.28

FIG. 4

Accident Record after Signal Installation. — An analysis of the accidents occurring in the twelve months since the traffic control signals have been installed indicate that 14 accidents have occurred in which a total of 12 persons were injured. This may accurately be compared with the twelve-month period just prior to the installation, when 21 accidents occurred in which 24 persons were injured. This shows that the traffic control signals have reduced the number of accidents by 33⅓ per cent, and the number of persons injured by 50 per cent. This reduction is even more important when it is known that the exposure to accidents as measured by the number of vehicles using the intersection has increased from 11,772 vehicles for the average day in 1929, to 14,123 vehicles for the average day in 1930, — an increase of 20 per cent. (See Fig. 4.)

A more detailed analysis of the character of the accidents indicated that, during the twelve months' period before signal installation, 11 out of the total of 21 accidents were due to cross movement (vehicles striking each other from right angles). This type of accident is the most severe, and the 11 accidents injured 19 persons. The installation of signals reduced the 11 cross movement accidents to 1 cross movement accident in which no one was hurt. However, the signals increased certain classes of accidents, the severity of which, however, was very slight. Thus, for example, the rear end collisions were increased from 0 to 2, and the unknown type of movement accidents were increased from 9 to 11. It is apparent that these signals are particularly valuable in the reduction of a particular type of accident, namely, the cross movement collision.

Conclusion. — The experiences with the signals installed at Pope's Corner has indicated that they have been very effective in the reduction of accidents. Not only has the total number of accidents been reduced, but the severity of each accident has been reduced by 25 per cent. This reduction has been brought about with a minimum of delay to the driving public. The signals have also served other useful purposes, such as making it possible for motorists to cross the Turnpike, even during the heaviest hour, without the irritation or hazard of having to worm their way into heavy lines of fast moving traffic.

SAFETY AT STREET CAR LOADING PLATFORMS

Contrary to expectations, a recent intensive study of the street car loading platforms on a fairly heavily traveled street in a metropolitan city revealed the surprising fact that accidents to pedestrians increased 113 per cent, collisions of all sorts 24 per cent, and the total resultant juries, 155 per cent. While this is a most unfavorable record for the fety islands, it is believed that if the changes noted under "conclu-ons" as contained herein are put into effect the safety islands will roduce the results for which they were originally installed.

The district is divided, alternately, into residential and business ctions. The street, save for about 200 feet of granite blocks, has a itulithic surface, and from curb to curb it has a width of 70 feet, with dewalks 16 feet wide on each side. There are 65 streets intersecting his street, five of which are cross streets, and there is a double line of ar tracks in the entire distance of two miles. The average daily traffic pon this thoroughfare during a sixteen-hour period is 22,406 vehicles. his artery is fed on the south by traffic from the southerly cities and owns of the metropolitan district, and on the north by many other unicipalities. It is part of a direct route to the Berkshires and to oints in New York State. This particular piece of roadway has been esignated a "through way," and each of the intersecting streets is roperly posted, requiring vehicles to come to a full stop before entrance ay be made.

EFFECT OF SAFETY ISLANDS UPON TRAFFIC

With a knowledge of the physical characteristics of this street efore it, the Department then made a survey of the traffic islands nd traffic conditions surrounding them. This consisted of a fifteen-inute check during the peak hour, by two trained observers, at each f the islands. This work extended over a period of ten days.

These islands are concrete, 90 feet in length, 4 feet wide, 6 inches igh, and are located between intersections. They serve principally s street car loading platforms, but are also used as "refuge" points by edestrians making their way across this street. The islands are ar-anged along this street so that the distance between them varies from 10 to 783 feet. This variation results from the irregular distances etween intersecting streets.

There are thirty-one of these platforms within the area under con-truction. It was found that at eleven of these islands the width of oadway between islands and curb is 16.4 feet; in seventeen instances he width is 19.6 feet; and in one case the width is 16 feet, tapering to 5 feet. Two others were in excess of 24 feet. In making the check at he islands, the investigators recorded the number of cars passing be-ween the islands and the curb, as well as the manner of their approach o the island. An example will serve to explain the method. At one f the islands, 153 cars were observed during the 15-minute period.

Despite the fact that of this number 27, or 17.6 per cent, approached the islands two abreast, only 4, or 2.6 per cent, having gained the area between the island and curb, attempted to pass another car. The number of instances in which cars approached the islands two abreast varied from 1 to 67, while the number of examples of cars which passed within the island areas two abreast varied from 4 to 107. At only seven of these islands did cars attempt to pass three abreast; at five of the islands this occurred once; at one, 31 times, and at another it happened twice.

It appears from casual observation that conditions on this street have caused motorists to select other routes for travel, and that such alternate routes have in consequence become troublesome accident centers.

General Conclusions Based on Observations

For the design and location of safety islands the results of these observations deserve careful consideration.

1. Successive safety islands ought always to be located at least 550 feet apart to permit vehicles to overtake one another between islands.

2. The prohibition of parking for a distance of 50 feet from each end of the islands will allow vehicles to make easy movements to the right of the islands, both as they enter and as they leave. Adequate enforcement should be provided to keep this distance clear of parked automobiles.

3. Standard lane widths should be used between the islands and the curbs.

4. A decrease in the efficiency of a street as a thoroughfare tends to transfer traffic to alternate routes and create new problems at many different locations.

5. Vehicles should be permitted to pass to the left of the structure in order not to reduce the efficiency of the street as a thoroughfare.

Compilation of Accident Data

The data relative to accidents which occurred between the two points previously mentioned were obtained by searching through both the local police records and those in the accident file of this office. This information was then tabulated so as to show the number and kinds of accidents which had taken place within this territory.

Safety Island Accident Study

To make the study before and after the installation of the islands erfectly fair, it was necessary to separate that period during which ne islands were under construction from the periods before and after onstruction.

From the information obtained it was found that the increase in ne total number of all types of accidents along this part of the street mounted to 24 per cent. The number of pedestrians struck increased 13 per cent, and in most cases such accidents were traceable to the lands. Persons so injured were struck while crossing to or from the lands. The increase of 46 per cent in the number of accidents which ave occurred after dark may well be related to conditions brought bout by the safety islands, as may be judged by the fact that in 18 ases the cars struck the safety island. In some instances operators ontended that the blinkers were not in operation. This may be questioned, but it is a likely inference that even though they were flashing hey were lacking in attractive power for warning motorists.

The records show one case of an operator not only striking the sland, but also hitting a pedestrian standing upon it.

Comparison of Accidents with Total for City

While the accidents along this portion of the street have continued o mount, those for the remainder of the city showed a slight downvard tendency. Owing to the volume of pedestrian and vehicular raffic which enters upon this way, accidents occurring within the area nder consideration may continue to show a proportionally higher ercentage than the remainder of the city, but not to the unwarranted legree which has appeared in the past.

Further Conclusions Based on Accident Analysis

The following conclusions are those which may be applied to lmost any similar installation of safety islands:

1. Any warning light for use on the approach end of a safety sland should be bright and make not less than 60 flashes per minute.

2. A steady light or reflector unit should be placed at the approach nd of the safety island.

3. Flood lighting of the nearer end of the island for the safety of edestrians should be used.

4. At locations where signals are installed, the stop line for vehicles

should be far enough back to permit pedestrians ample space in which to walk directly from the sidewalk to the safety island.

5. A physical means should be provided at the approach ends of the safety islands to ward off automobiles which may strike the abutments.

Delay and Accident Study to Justify Intersection Design such as Grade Separation or Rotary Traffic

The Department has studied a number of intersections in the metropolitan area to determine whether the construction of a grade separation or a rotary traffic system would be justified.

In order actually to establish the facts, volume, delay and accident studies were made to serve as a basis for measuring the relative needs of each intersection.

These intersections, while varying widely as to total volume and total delay, may be classified in three divisions:

First, those at which there is no form of control.

Second, those controlled by signals, automatic, full actuated or manual.

Third, those controlled partially or full time by traffic officers.

From the observations made it would appear in general that delay is higher under officer control, and that automatic signals are more efficient than signals controlled manually. For low flows, control by either officer or signal is unnecessary and causes additional delay.

In general, delay follows volume, but in no specific ratio. This is probably because of physical characteristics peculiar to each intersection.

One of the most important physical characteristics affecting the capacity of an intersection and delay experienced by those using the intersection is width, a multi-lane road having greater capacity than the single lane type.

As an indication of the need for a grade separation at an intersection, a method has been devised for estimating the justifiable expenditure for such a project. This method takes into consideration the total number of vehicles passing the intersection, the delay to each on account of stopping at signals and the delay due to lessened speed through the intersection, and the accident loss, all as determined by counts of traffic and records of delay as actually measured. From the actual counts and original data taken on certain dates, there are derived the annual figures, by the use of factors giving the relation of the anual figures to the average day or month, which are assumed to be proportional to the gasoline consumption for the year.

Assuming that the value of the average motor vehicle hour is $1, a fatality $5,000, an injury $175, property damage $30 per vehicle nvolved, and that the life of a structure or layout providing separation of grades is twenty years, there may be estimated a figure for consideration as a justifiable expenditure for such a separation, this figure being twenty times the figured annual loss due to delays and accidents.

As representing this procedure two cases are assumed, as indicated in Table I, in which it is evident that the delay factor is important in determining the justifiable expenditure. It is not maintained that such a study is other than a means of indicating the relative importance of any number of such cases.

TABLE I

INTERSECTION	Yearly Volume (Number of Cars)	Yearly Delay (Motor Vehicle Hours)	YEARLY LOSS			Justifiable Expenditure
			Traffic	Accidents	Total	
A	8,500,000	17,000	$17,000	$4,500	$21,500	$430,000
B	9,300,000	7,700	7,800	1,000	8,800	176,000

CONCLUSION

The value of factual studies in traffic control has been demonstrated so completely that there remains no excuse for proceeding upon guesswork. The experience in Massachusetts and the reaction which it has been accorded indicate that the general movement is popular and will continue to expand.

OF GENERAL INTEREST

MEMOIR

George Bowers *

DIED FEBRUARY 28, 1930

GEORGE BOWERS, the son of Sewall and Sylvia (Fisher) Bowers, was born on October 30, 1848, in Middlesex Village, Lowell, then a part of Chelmsford, Massachusetts. His English ancestry is traced from Michael de Bures, who was seated in Dorset, England, in 1075. His earliest paternal ancestor in America was George Bowers, whose son Jerathmel built the Bowers homestead in 1695 on land granted from the King of England. Mr. Bowers lived in this house many years, and the home still remains in the family, having passed down from generation to generation.

George Bowers' early education was that gained in the local schools of Middlesex Village and Lowell. He began his engineering work in the city engineer's office in Lowell, where he remained two years before entering the Massachusetts Institute of Technology with the class of 1875. After leaving the Institute he was employed as first assistant engineer on the construction of the Waltham Water Works.

Returning to Lowell he became first assistant city engineer, and was elected city engineer in 1887, a position which he filled for one year. He was reelected city engineer in 1891, and thereafter filled the office continuously till 1911.

Mr. Bowers' most notable work was that in providing the present water supply system of Lowell, which remains as a monument to his memory. Recurrent outbreaks of typhoid fever were a menace so long as the city took its water from the Merrimac River. In 1893, as city engineer, he carried on an extensive series of experiments with driven wells which demonstrated the practicability of supplying Lowell with pure water from such source. In 1895, against strong political opposition, he succeeded in installing the present driven well supply at a time when Lowell was in the grip of a typhoid fever epidemic.

After retiring from the office of city engineer, Mr. Bowers engaged in consulting engineering practice, particularly in the sanitary fields of water supply and disposal of wastes, in which he was specially qualified because of the experience gained in his progressive municipal work for the city of Lowell. Among his clients were the town of Chelmsford, where he planned and supervised the construction of a new driven well water supply, the Nashua Manufacturing Company, and the American Hide and Leather Company, for both of which he handled problems of water supply and waste disposal.

During the latter part of his life Mr. Bowers was actively identified with the Lowell Institution for Savings. In this bank he was elected a trustee, a vice president, and a member of the board of investment in 1904, positions which he filled continuously until, at his death, he was first vice president and chairman of the board of investment.

Mr. Bowers was elected a member of

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* Memoir prepared by Frederick H. Fay, Boston.

he Boston Society of Civil Engineers March 17, 1886, and served as a Di-ector in 1908 and 1909. He became a nember of the New England Water Works Association on March 9, 1892, nd was president of that association n 1905. He became a member of the American Society of Civil Engineers, October 1, 1902. He was a member of the Engineers Club of Boston, the Vesper Country Club, and several historical and philanthropic societies. All his life he was an active and devoted member of the Unitarian Church.

On October 24, 1878, Mr. Bowers married Estelle L. Wilkins, who survives him. He also leaves a daughter, Helen E. Bowers, and two sons, George W. and Alton R. Bowers.

Ability, sterling worth, unflinching honesty, force of character, a kind heart and a companionable nature — these are some of the many qualities which won for George Bowers a wide circle of loyal friends. In his passing, the engineering profession has lost a valued member, and the city of Lowell an outstanding citizen.

PROCEEDINGS OF THE SOCIETY

MINUTES OF MEETINGS

Designers Section

January 14, 1931. — A regular meeting of the Designers Section was called to order at 6.10 P.M. by the Vice Chairman, LeRoy M. Hersum, in the Affiliation Rooms.

The minutes of the December meeting were read and approved.

The speaker of the evening was Mr. Kimball R. Garland, structural designer with J. R. Nichols of Boston, whose subject was "Columns subjected to Eccentric and Transverse Loading." Mr. Garland discussed the relative importance of different factors affecting the strength of columns subjected to eccentric and transverse loading, using many practical cases for examples.

At the conclusion of the talk the meeting was opened to general discussion.

There were thirty-seven members and guests present.

The meeting adjourned at 7.30 P.M.

Lawrence G. Ropes, *Clerk.*

Northeastern University Section

January 20, 1931. — The regular meeting of the Northeastern University Section of the Boston Society of Civil Engineers was held on Friday evening, January 9, 1931, in 18H of the Huntington Building, at 7.30 P.M. Chairman John H. Lowe presided.

The speaker of the evening, Mr. Albert O. Wilson, was introduced by Carl A. Magnuson, clerk. Mr. Wilson, a graduate of Massachusetts Institute of Technology in 1911, is the president of the A. O. Wilson Structural Company of Cambridge. He is also president of the Bay State and Steel Manufacturers Association, and a member of the Boston Society of Civil Engineers.

Mr. Wilson chose "Twin Ignition Engineering" as his topic, and developed it by bringing in the qualities which he considered desirable in the young engineer of today; character, personality, practical ability and scholarship were his basis for judging a young man entering the engineering profession.

Mr. Wilson showed three reels of motion pictures dealing with structural engineering. Two of these films dealt with the steel construction work on the new Manhattan Building in New York City. The third film was entitled "Battle-deck Floors," a new type of iron floor which is coming to the front in this era of steel construction.

Following his discourse the speaker

answered several questions which were presented regarding shop design and estimates on steel construction today.

Previous to the meeting the members in attendance had a buffet supper at the Café Paris.

There were eighteen members present.

The meeting adjourned at 9.30 o'clock.

CARL A. MAGNUSON, *Clerk.*

APPLICATIONS FOR MEMBERSHIP

[FEBRUARY 20, 1931]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

For Admission

ROLIN, RAYMOND GUSTAF, Lynn, Mass. (Age 22, b. Lynn, Mass.) Graduate of Massachusetts Institute of Technology, class of 1930. At present engaged as assistant in the civil engineering department, Massachusetts Institute of Technology. Refers to *J. B. Babcock, H. K. Barrows, W. A. Liddell, C. M. Spofford.*

TAGGART, JR., JOHN C., Boston, Mass. (Age 33, b. New Castle, Pa.) Graduate of New Castle High School; Washington and Jefferson College, 1915–17; ensign in United States Navy, 1918 to May, 1919; University of Michigan (civil engineering), 1919–23; Ford Motor Company, 1923–24, in charge of a surveying corps; Fisher Body Corporation (General Motors), 1924–27, factory designing and inspector on steel erection; Carnegie Steel Company, 1927 to date, sales engineer, structural department, transferred to Boston as engineer in New England District (November 1, 1930), and so employed at present. Refers to *J. E. Carty, W. S. Locke, L. E. Moore, S. P. Waldron.*

Transfer from Grade of Junior

WINCH, NORMAN MACKENZIE, Framingham, Mass. (Age 24, b. Dorchester, Mass.) Graduated from Northeastern University in June, 1928. While attending the University worked with Mr. J. J. Van Valkenburgh as rodman, instrumentman, chief of party, inspector and draftsman. Since graduating has been with the engineering department of the town of Needham as assistant engineer, which position he now holds. Refers to *H. B. Alvord, C. O. Baird, L. C. Hollis, J. W. Ingalls, J. J. Van Valkenburgh.*

ADDITIONS

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THOMAS R. CAMP, 33 Copley Street, Newton, Mass.

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Juniors

JOHN W. COPITHORNE, 45 Upland Road, West Somerville, Mass.

JACOB GINSBURG, 183 Paris Street, East Boston, Mass.

CHARLES V. MACCARIO, 970 Salem Street, Malden, Mass.

DEATHS

CHARLES A. MASON	December 31, 1930
JOHN E. TITUS	January 18, 1931

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FOUNDED 1848

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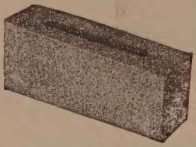

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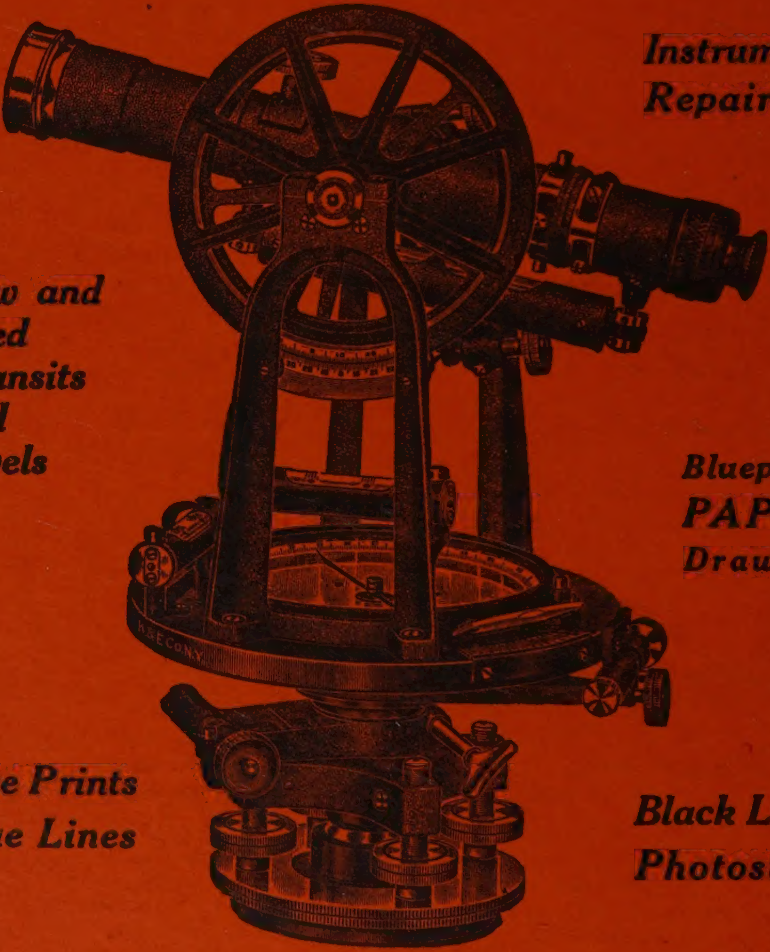

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